CLAIMS

We claim:

1. A proportional valve for controlling the pressure of a fluid inside a container between first and second fluid pressure levels, said second pressure level being larger than said first pressure level, said container having an opening extending into an inner volume thereof, said proportional valve comprising:

- a fluid outflow passageway having an exhaust opening, said outflow passageway being in fluid communication with the container inner volume;
- an actuatable fluid inflow passageway having an intake opening;
- an actuatable exhaust cover for selectively closing said exhaust opening;
- said fluid outflow passageway, said actuatable fluid inflow passageway and said actuatable exhaust cover being interconnected and configured such that:

  - in response to a moving force reaching a first pre-determined threshold said actuatable exhaust cover is being displaced from a first cover position in which said exhaust cover is spaced apart from said exhaust opening to allow fluid to exhaust therethrough from the container inner volume to a second cover position in which said exhaust cover closes off said exhaust opening to prevent fluid from exhausting from the container inner volume; and
  - in response to the moving force reaching a second pre-determined threshold said actuatable fluid inflow passageway is being displaced from a first inflow passageway position in which said fluid inflow passageway is closed to prevent fluid from flowing between said fluid inflow passageway and the container inner volume to a second inflow passageway position in which said fluid

inflow passageway is in fluid communication with said fluid outflow passageway to allow fluid to flow between said fluid inflow passageway and the container inner volume.

2. The valve of claim 1, wherein said exhaust cover is displaced by a cover displacement amount between said first and second cover positions, and wherein said fluid inflow passageway is displaced by an inflow passageway displacement amount between said first and second inflow passageway positions.

3. The valve of claim 2, further comprising:

- an actuator member connecting to said exhaust cover and said fluid inflow passageway, said actuator member providing the moving force for displacement of said exhaust cover and said fluid inflow passageway by said cover and inflow passageway displacement amounts, respectively.

4. The valve of claim 3, wherein said actuator member is operable to first and second actuator displacement configurations, said first actuator displacement configuration corresponding to said exhaust cover and said fluid inflow passageway in said second cover position and said first inflow passageway position respectively, said second actuator displacement configuration corresponding to said exhaust cover and said fluid inflow passageway in said second cover position and said second inflow passageway position respectively.

5. The valve of claim 4, wherein said actuator member is operable in response to an actuating force, said actuating force inducing said first and second actuator displacement configurations when reaching first and second pre-determined force levels, respectively.

6. The valve of claim 5, wherein said first and second pre-determined force levels are between about one and about four orders of magnitude larger than the moving force.

7. The valve of claim 6, wherein first and second pre-determined force levels are about two orders of magnitude larger than the moving force.

8. The valve of claim 6, wherein said fluid outflow passageway extends through a valve seat mounted on the container and surrounding the opening thereof and wherein said fluid inflow passageway extends through an intake body movably connected to said valve seat, said actuatable exhaust cover movably mounting on said intake body.

9. The valve of claim 8, wherein said intake body includes a body biasing means urging said intake body in said first inflow passageway position.

10. The valve of claim 9, wherein said body biasing means urges said intake body in said first inflow passageway position with a pre-determined biasing force, said pre-determined biasing force being intermediate said first and second pre-determined threshold forces.

11. The valve of claim 10, wherein said actuator member includes first and second actuator components connecting to said exhaust cover and said intake body, the actuating force displacing said first and second components relative to one another into said first and second actuator displacement configurations corresponding to said cover and inflow passageway displacement amounts, respectively.

12. The valve of claim 11, wherein said first and second actuator components are first and second resilient plate members respectively, said first and second plate members peripherally and sealably attaching to one another in a face-to-face configuration, said first and second plate members defining respective central section thereof and an actuator inner volume therebetween, said actuator inner volume being selectively in fluid communication with a source of pressurized fluid so as to selectively move said central sections away from one another into said first and second actuator displacement configurations.

13. The valve of claim 12, wherein said first and second plate members, when said central sections are positioned away from one another, form an actuator biasing spring urging central sections toward one another into an idle actuator configuration corresponding to said exhaust cover and said fluid inflow passageway in said first cover and first inflow passageway positions, respectively.

14. The valve of claim 13, wherein said central sections connect to said exhaust cover and said intake body.

15. The valve of claim 14, wherein said fluid inflow passageway is generally rectilinear and defines generally longitudinally opposed first and second inflow passageway ends and a longitudinal inflow passageway axis, said first and second inflow passageway ends being positioned generally adjacent and away from said valve seat respectively, said first inflow passageway end being in contact with and spaced apart from said valve seat when in said first and second inflow passageway positions, respectively.

16. The valve of claim 15, wherein said body biasing means includes an elongate plunger member extending longitudinally through said fluid

inflow passageway and a compressive spring, said plunger member having a first longitudinal plunger end connected to said valve seat and a generally opposed second longitudinal plunger end connected to said inflow passageway at a position intermediate said first and second inflow passageway ends via said compressive spring, said compressive spring urging said first inflow passageway end in contact with said valve seat to close off said inflow passageway in said first inflow passageway position.

17. The valve of claim 16, wherein said compressive spring is a helical spring.

18. The valve of claim 17, wherein said actuatable exhaust cover mounts on said first plate member for axial movement relative to said intake body adjacent said first inflow passageway end.

19. The valve of claim 18, wherein said actuator inner volume is in fluid communication with a source of a variable pressurized fluid so as to selectively adjust said fluid pressure therein such that said actuator member is adjustable between said idle actuator configuration and said first and second actuator displacement configurations.

20. The valve of claim 19, wherein said central section of one of said first and second plate members includes an actuator opening extending therethrough, said actuator opening allowing said actuator inner volume to be in fluid communication with the source of variable pressurized fluid.

21. The valve of claim 20, wherein said central sections of said first and second plate members are in contact with said inflow passageway adjacent said first inflow passageway end and at a position intermediate said first and second inflow passageway ends, respectively.

22. The valve of claim 21, wherein said exhaust cover includes a locally generally flexible component to contact and sealably close off said exhaust opening in said second cover position.

23. The valve of claim 22, wherein said exhaust and intake openings are connectable to fluids at said first and second pressure levels, respectively.

24. The valve of claim 1, wherein said second pre-determined threshold force is larger than first pre-determined threshold force.